

2010-2011 PROGRESS REPORT

**UTC — CARRIER AIR CONDITIONING
COLLIERVILLE, TENNESSEE**

EPA ID: TND04406222

Prepared for:

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Acronyms and Abbreviations

Carrier	Carrier Air Conditioning
bgs	below ground surface
cis-1,2 DCE	cis-1,2 dichloroethylene
GAC	granular activated carbon
gpm	gallons per minute
lbs	pounds
mg/m ³	milligrams per cubic meter
MPA	Main Plant Area
NRS	North Remediation System
O&M	operation and maintenance
P&ID	process and instrumentation diagram
POTW	Publicly Owned Treatment Works
RD/RA	Remedial Design and Remedial Action
ROD	Record of Decision
scfm	standard cubic feet per minute
SSV	sub-slab ventilation
SVE	soil vapor extraction
TCE	trichloroethylene
TDOT	Tennessee Department of Transportation
µg/Kg	micrograms per kilogram
µg/L	micrograms per liter
UAO	Unilateral Administrative Order
USEPA	United States Environmental Protection Agency
UTC	United Technologies Corporation
VOCs	volatile organic compounds
WP#2	Water Plant #2
WPC	Water Pollution Control
XDD	XDD, LLC

1.0 INTRODUCTION

This progress report outlines activities undertaken at the United Technologies Corporation (UTC) Carrier Air Conditioning (Carrier) facility located at 97 South Byhalia Road in Collierville, Tennessee (site) pursuant to the Unilateral Administrative Order (UAO) for Remedial Design and Remedial Action (RD/RA). Remedial actions have been implemented at the Carrier site in accordance with the Record of Decision (ROD) issued for the site by the United States Environmental Protection Agency (USEPA) in 1992. This report describes the work conducted and data collected from January 2010 through December 2011. It includes the plans, data, activities, and procedures completed and pending for groundwater and soil remediation at the Carrier Site. The two year time span (2010 and 2011) covered in this progress report is intended to provide continuity with the *2009 EPA Five-Year Review Report* [E², Inc., 2010].

The following remediation systems operate at the site:




1. The operation of the Town of Collierville's Water Plant #2 (WP#2) contains the groundwater plume in the Memphis Sand, and controls exposure through treatment. The plant includes two extraction wells with two five-foot diameter air strippers to remove trichloroethylene (TCE) and other volatile organic compounds (VOCs) from the groundwater.
2. The North Remediation System (NRS) extracts TCE and other VOCs from soils impacted by the former lagoon via soil vapor extraction (SVE).
3. The Main Plant Area (MPA) SVE system extracts TCE and other VOCs from soils impacted by historical spills near the main plant. The MPA sub-slab ventilation (SSV) system also operates as an additional protective measure to prevent the potential migration of sub-slab VOC vapors into the MPA facility expansion building.

The three remediation systems are shown along with the existing monitoring wells in **Figure 1-1**. The NRS system operated continuously during the 2010-2011 period, with exception of a few temporary shutdowns pending non-routine repairs and maintenance. The MPA system operated





LEGEND:

-  MONITORING WELL
-  PUMPING WELL
-  APPROXIMATE PROPERTY LINE



NOTE: MONITORING WELL LOCATIONS ARE APPROXIMATE.

180' 0' 180' 360'

SCALE: As Shown
 DATE: May 11, 2011
 PROJECT NO.: 73210
 CLIENT: UTC - Collierville
 DRAWN BY: MAW
 CHECKED BY: OU
 PROJ. MGMT. APPROVAL: BC



TITLE: Active Remediation Systems and Monitoring Wells

DRAWING NO.: FIGURE 1-1

REV: B

continuously during the 2010-2011 period with the exception of a few temporary shutdowns. pending repairs and/or vapor-phase granular activated carbon (GAC) change-outs.

WP#2 operated continuously during the 2010-2011 period, except for stoppages due to high rainfall events as dictated by the Town of Collierville's Publically Owned Treatment Works (POTW), and routine repairs and maintenance. WP#2 operated at a discharge flow rate of approximately 500 gallons per minute (gpm) into the Town of Collierville's POTW utilizing only the West well.

The background information regarding chromium impacts to WP#2, as well as the MPA system reconstruction activities were discussed in detail in the *2004 Five-Year Review*, prepared on behalf of the USEPA by EnSafe, Inc. (EnSafe) and XDD in 2005, and the *2007-2008 Annual Progress Report*, prepared on behalf of the USEPA by XDD in 2009. The activities undertaken in 2009, were discussed in detail in the 2009 Five-Year Review, prepared on behalf of the USEPA by E², Inc. in 2010.

2.0 GROUNDWATER

WP#2 has operated continuously since November 2007 utilizing the West well at a flow rate of approximately 500 gpm. Consistent with previous operations, extracted groundwater from WP#2 was treated to remove dissolved phase VOCs using the air stripping towers. The treated water was then discharged directly into the Town of Collierville's POTW instead of the Town of Collierville's potable water supply system. The Town of Collierville has required the discharge of water from WP#2 to go to the POTW while chromium in the discharge water is above the detection limits of 10 micrograms per liter ($\mu\text{g/L}$). In accordance with the interim agreement with the Town of Collierville, operations were temporarily suspended during high rainfall events to minimize adverse hydraulic impacts at the POTW. Operations are typically restarted 24 to 48 hours after such events.

2.1 Groundwater Monitoring

Throughout the reporting period, groundwater samples were collected as outlined in the *Groundwater Remedy Design Report* (EnSafe, 1994) from existing downgradient off site monitoring wells MW-60 and MW-62, the Town of Collierville's WP#2 West well (influent to the air stripping towers) and from the air stripper's effluent. The air stripper's influent (groundwater from the West well) and the air stripper's effluent were tested quarterly for VOCs. The effluent was also analyzed for total chromium and hexavalent chromium. On-site monitoring wells MW-4, MW-10, and MW-31R were sampled quarterly and analyzed for VOCs, lead, and zinc.

Copies of the laboratory analytical reports for the groundwater sampling performed during 2010 and 2011 are provided in **Appendix A**.

2.1.1 Groundwater Analytical Results from MW-31R

As discussed in the *2006 Annual Progress Report*, in July 2006 Carrier installed a new monitoring well, MW-31R, in replacement of well MW-31, which was destroyed by Tennessee Department of Transportation (TDOT) road construction/expansion activities in 2000. MW-31R was installed in the southeast corner of Carrier's property as close to the original location as possible. The approximate location of MW-31R is shown on **Figure 1-1**. The well was



constructed in a similar manner as MW-31 to monitor groundwater conditions in the perched groundwater above the Jackson Clay and to measure effectiveness of the soil remediation system in place at the MPA.

As discussed previously, MW-31R was sampled quarterly during 2010 and 2011. Results from 2010 and 2011 monitoring are provided in **Table 2-1**. The historical groundwater data from MW-4/MW-10/MW-31, along with the monitoring results of MW-31R were presented in the *2007-2008 Annual Progress Report*, prepared on behalf of the USEPA by XDD in 2009. Groundwater TCE concentrations detected at MW-31R from 2010 through 2011 are comparable to historical data from MW-31. Carrier will continue to monitor TCE concentrations in groundwater at MW-31R on a quarterly basis in 2012.

Table 2-1 Groundwater Concentrations from MW-31R, MW-4, and MW-10 (2010-2011)						
Well	Date	Chemicals				
		TCE	cis-1,2-DCE	VC	Pb	Zn
MW-31R	3/30/2010	3.8	<2	<2	6.7	113
	6/21/2010	3.7	4.8	<2	4.4	60
	9/22/2010	3.6	<2	<2	6.8	36.1
	12/20/2010	2.9	2.1	<2	12.4	107
	3/22/2011	3.6	2.1	<2	19.5	133
	6/29/2011	1.5	1.2	<1	13.2	101
	9/28/2011	1.5	<1	<1	7.7	105
	12/18/2011	2.6	3.7	<1	6.7	87.4
MW-4	3/30/2010	1,390	2,160	<50	100	26,400
	6/21/2010	1,450 a	2,030 a	3.1	27.1	4,640
	9/22/2010	3,180 a	3,240 a	3.9	16	5,350
	12/20/2010	3,320 a	3,010 a	<10	12.7	3,580
	3/22/2011	3,170 a	2,790 a	<10	8.4	1,160
	6/29/2011	2,730 a	2,470 a	<5	10.6	1,670
	9/28/2011	2,060 a	2,020 a	2.4	4.4	1,330
	12/18/2011	2,000 a	2,120 a	1.8	20.9	3,600
MW-10	3/30/2010	56,700 a	320	<50	<3.0	26.6
	6/21/2010	52,200 a	432	<100	<3.0	<20
	9/22/2010	19,400 a	155	<100	3.3	<20
	12/20/2010	37,500 a	227	<40	6.9	<20
	3/22/2011	31,500 a	185	<40	16.3	<20
	6/29/2011	36,400 a	188	<25	3.5	<20
	9/28/2011	20,100 a	80.5	<25	3.6	<20
	12/18/2011	16,600 a	98.1	<20	4.9	<20

Notes:

All units are in µg/L.

a : Result is from Run # 2

<1 : Not detected - Chemicals below the laboratory reporting/quantification limit

TCE : trichloroethylene

cis-1, 2, DCE : cis-1, 2-dichloroethylene

VC

: vinyl chloride

Pb

: lead

Zn

: zinc

2.1.2 Groundwater Analytical Results from MW-4

Monitoring well MW-4 was sampled quarterly during 2010 and 2011 to monitor conditions immediately downgradient of the recharge area that is monitored by MW-31R. MW-4 is

screened within the Memphis Sands, with a completion depth approximately 25 feet deeper than MW-31R. Results from 2010 and 2011 monitoring are presented in **Table 2-1**.

The detected concentrations of TCE ranged from 1,390 µg/L (March 2010) to 3,320 µg/L (December 2010) during the reporting period. The detected concentrations of zinc ranged from 1,160 µg/L (March 2011) to 26,400 µg/L (March 2010) during the reporting period. As discussed in the *2004 - 2005 Annual Progress Report* (EnSafe/XDD, 2006), elevated zinc concentrations in MW-4 since 1991 (based on historical RI data) were most likely due to corrosion of the well's galvanized steel riser. Carrier will continue to monitor TCE concentrations in groundwater at MW-4 on a quarterly basis in 2012.

2.1.3 Groundwater Analytical Results from MW-10

In accordance with the *2007-2008 Annual Progress Report*, monitoring well MW-10 was sampled quarterly during 2010 and 2011 to evaluate the elevated TCE concentrations at this well. Results from 2010 and 2011 monitoring are presented in **Table 2-1**. The detected concentrations of TCE ranged from 16,600 µg/L (December 2011) to 56,700 µg/L (March 2010) during the reporting period. Carrier will continue to monitor TCE concentrations in groundwater at MW-10 on a quarterly basis in 2012.

2.1.4 Groundwater Analytical Results from MW-60 and MW-62

Downgradient monitoring wells MW-60 and MW-62 were sampled monthly during 2010 and 2011. Results from 2010 and 2011 monitoring are presented in **Table 2-2**. The absence of VOCs in these wells in 2010 and 2011 indicates that plume capture is maintained by pumping of the West well. Overall, this data indicates that the groundwater TCE plume remains contained as required in the USEPA interim shutdown approval, dated December 22, 2006 and the 1992 ROD.

Chromium was not detected in these wells above the laboratory analytical detection/reporting limits during the reporting period. During a few sampling events, lead and zinc were detected in these wells above the laboratory detection/reporting limits. Lead was detected at 6.9 µg/L in

MW-60 during March 2011, and 3.0 µg/L in MW-62 during December 2010. Zinc was detected at 36.1 µg/L in MW-60 during June 2010 and 50.4 µg/L during March 2011. However, the majority of these detected zinc concentrations were slightly above the laboratory reporting limits (i.e., limits of quantification).

Table 2-2 Groundwater Concentrations from MW-60 and MW-62 (2010-2011)												
Date	MW-60						MW-62					
	TCE	cis-1,2-DCE	VC	Cr (VI)	Pb	Zn	TCE	cis-1,2-DCE	VC	Cr (VI)	Pb	Zn
1/27/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
2/27/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
3/30/2010	<2	<2	<2	<10	<3.0	<20	<2	<2	<2	<10	<3.0	<20
4/16/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
5/19/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
6/21/2010	<2	<2	<2	<10	<3.0	36.1	<2	<2	<2	<10	<3.0	<20
7/29/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
8/23/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
9/22/2010	<2	<2	<2	<10	<3.0	<20	<2	<2	<2	<10	<3.0	<20
10/21/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
11/8/2010	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
12/20/2010	<2	<2	<2	<10	<3.0	<20	<2	<2	<2	<10	3.0	<20
1/27/2011	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
2/25/2011	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
3/22/2011	<2	<2	<2	<10	6.9	50.4	<2	<2	<2	<10	<3.0	<20
4/19/2011	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
5/31/2011	<2	<2	<2	-	-	-	<2	<2	<2	-	-	-
6/29/2011	<1	<1	<1	<10	<3.0	<20	<1	<1	<1	<10	<3.0	<20
7/14/2011	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-
8/11/2011	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-
9/28/2011	<1	<1	<1	<10	<3.0	<20	<1	<1	<1	<10	<3.0	<20
10/20/2011	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-
11/29/2011	<1	<1	<1	-	-	-	<1	<1	<1	-	-	-
12/14/2011	<1	<1	<1	<10	<3.0	<20	<1	<1	<1	<10	<3.0	<20

Notes:

All units are in µg/L

- : Chemicals not analyzed/data not collected
 <1 : Not Detected - Chemicals below the laboratory reporting/quantification limit
 TCE : trichloroethylene

cis-1, 2, DCE : cis-1, 2-dichloroethylene
 Zn : zinc
 VC : vinyl chloride
 Cr (VI) : hexavalent chromium
 Zn : zinc
 Pb : lead



Carrier will continue to monitor TCE and chromium concentrations in groundwater at MW-60 and MW-62 on a bi-monthly basis in 2012.

2.1.5 Groundwater Analytical Results from Water Plant #2

WP#2 Influent Monthly Data

Figure 2-1 presents the monthly average TCE concentration trends for the influent water to the air stripper tower at WP#2 from January 2010 through December 2011. The laboratory analytical data from 2010 and 2011 is provided in **Appendix A**.

Figure 2-1 Water Plant #2 Influent Monthly Average TCE Concentrations

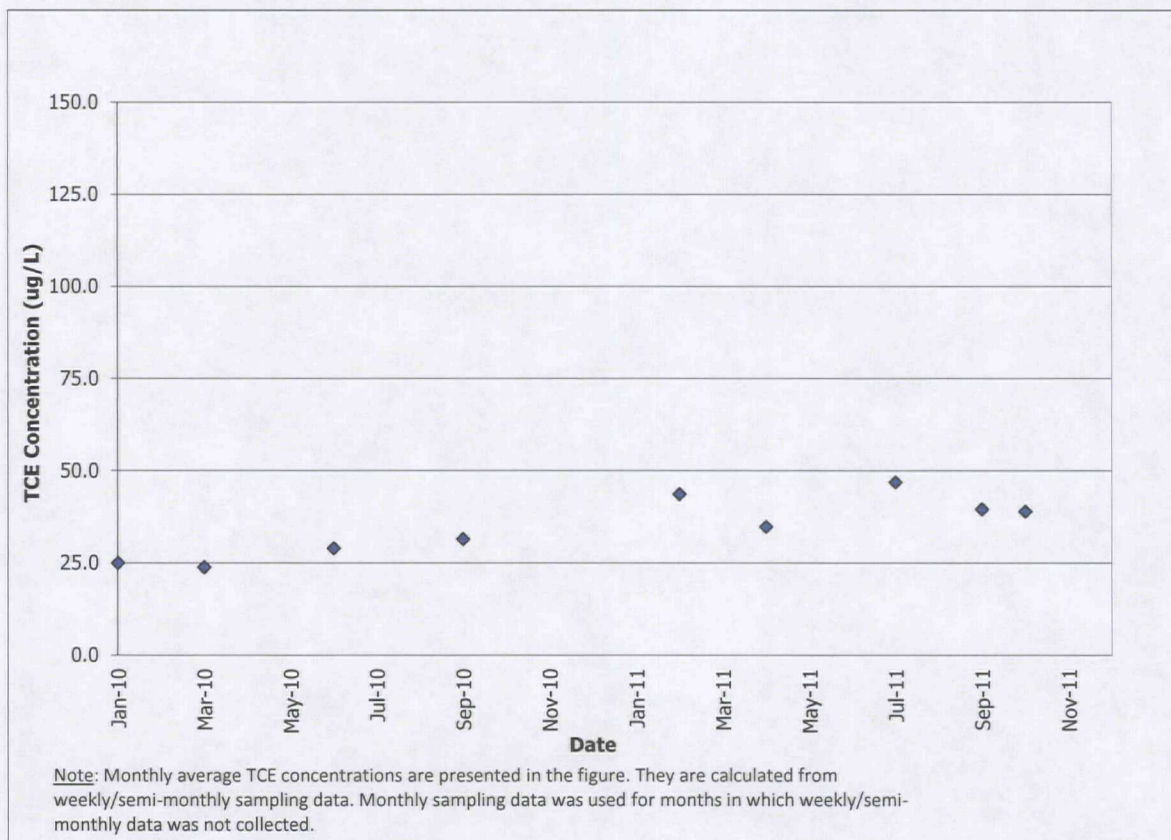


Table 2-3 presents the monthly TCE and cis-1,2 dichloroethylene (cis-1,2 DCE) concentrations before and after the groundwater is processed through the air stripping column during 2010 and 2011.

Table 2-3 Water Plant #2 Monthly Average Air Stripping Column Concentrations (2010-2011)				
Month	Influent		Effluent	
	cis-1,2 DCE	TCE	cis- 1,2 DCE	TCE
	(µg/L)	(µg/L)	(µg/L)	(µg/L)
January-10	< 2	25.0	< 2	< 2
February-10	< 2	< 2.0*	< 2	< 2
March-10	< 2	23.9	< 2	< 2
June-10	< 2	29.0	< 2	< 2
September-10	< 2	31.5	< 2	< 2
February-11	< 2	43.7	< 2	< 2
April-11	<2	34.8	<2	<2
July-11	<1	46.9	<1	<1
September-11	<1	39.6	<1	<1
October-11	<1	39.0	<1	<1

Notes:

<2 : Not Detected - Chemicals below the laboratory reporting/quantification limit
 TCE : trichloroethylene
 µg/L : micrograms per liter
 cis-1,2 DCE : cis-1,2 dichloroethylene

*February 2010 analytical result for WP#2 is anomalous, as detections were observed in January and March 2010. Results from January 2010 will be used for mass removal purposes.

As presented on **Figure 2-1**, TCE concentrations in the air stripper influent have remained consistent over the reporting period, with concentrations averaging less than 50 µg/L. Historical air stripper influent data was presented in the 2007-2008 Annual Progress Report.

Data from the air stripping units showed consistent effluent concentrations below the laboratory detection limits throughout the reporting period, indicating that the air strippers are performing as designed.

2.2 Water Plant #2 Operation

From January 2010 through December 2011, approximately 202 million gallons of water were pumped and treated at WP#2. Appendix B includes monthly flow data for WP#2 during 2010 and 2011. **Table 2-4** presents the monthly flow rates and mass removal data during 2010 and 2011.

Table 2-4			
Water Plant#2 TCE Removal (2010 - 2011)			
Sampling Date	Total Flow (gallons)	TCE Concentration (µg/L)	TCE Mass Removal (lbs)
January-10	1,478,715	25.0	0.31
February-10	10,815,676	25.0*	2.26
March-10	5,293,777	23.9	1.06
April-10	13,228,326	23.9**	2.64
May-10	14,747,209	23.9**	2.94
June-10	7,932,021	29.0	1.92
July-10	10,996,025	29.0**	2.66
August-10	--	--	--
September-10	11,975,337	31.5	3.15
October-10	15,346,392	31.5**	4.04
November-10	8,230,070	31.5**	2.16
December-10	--	--	--
January-11	2,330,122	31.5**	0.61
February-11	8,331,384	43.7	3.04
March-11	9,791,397	43.7**	3.57
April-11	5,644,946	34.8	1.64
May-11	9,119,255	34.8**	2.65
June-11	13,194,244	34.8**	3.83
July-11	6,966,454	46.9	2.73
August-11	8,478,296	46.9**	3.32
September-11	13,516,683	39.6	4.47
October-11	14,398,177	39.0	4.69
November-11	6,002,366	39.0	1.95
December-11	4,610,286	39.0	1.50
2010-2011 Total	202,427,158		57.1

Notes:

TCE : trichloroethylene
 lbs : pounds
 µg/L : micrograms per liter

*Due to anomalous non-detect (ND) analytical results in February 2010, analytical results collected in January 2010 were used for mass removal calculations.

--No samples collected.

**Previous month's analytical data used for mass removal calculations.

-2009 mass removal was estimated to be 21.6 lbs.

-WP#2 was shut down during the months of August and December 2010 for repairs and winter holidays.

Monthly flow rates at WP#2 from January 2010 through December 2011 ranged from 1.4 million gallons per month to 15.3 million gallons per month. The removal rates were calculated using the monthly concentrations and monthly flow volumes. Approximately 57 pounds (lbs) of TCE mass were removed in 2010 and 2011. Details of the monthly operations and removal rate calculations are provided in **Appendix C**.

As of this report, approximately 6,077 lbs of TCE has been removed from water pumped at WP#2.

2.3 Water Plant #2 O&M

Following the 2007 interim shutdown period, WP#2 was reactivated on November 27, 2007 to maintain containment of the VOC plume and configured to continuously discharge at a rate of approximately 500 gpm into the Town of Collierville's POTW, after treatment via an air stripper, utilizing only the West well. Since being reactivated, WP#2 has operated continuously through December 2011 with the exception of temporary shutdowns during high rainfall events (as dictated by the Town of Collierville's POTW) and a few temporary shutdowns pending routine maintenance and repairs. No major unscheduled maintenance tasks have been required during 2010 and 2011.

2.4 Groundwater Monitoring and Water Plant #2 Planned 2012 Activities

As of this report, Carrier is planning to perform the following activities in 2012:

- Monitoring wells MW-4, MW-10, and MW-31R will be sampled semi-annually during 2012 for VOCs, lead, and zinc.
- Monitoring wells MW-60 and MW-62 will be sampled monthly during 2012 for VOCs, lead, zinc, chromium, and hexavalent chromium.

- WP#2 will operate in interim status during 2012 using the West well pumping at approximately 500 gpm to maintain containment of the TCE plume. Consistent with previous operations, extracted groundwater will be treated to remove dissolved phase VOCs using the air stripping towers with the water being discharged to the Town of Collierville's POTW.
- The raw/influent water concentrations at WP#2 will continue to be monitored quarterly for VOCs during 2012 to gauge the effectiveness of the source area remediation systems.

3.0 SOIL

The following sections discuss the operation and findings of the MPA and NRS SVE remediation systems at the site.

3.1 MPA System

The MPA SVE system was implemented in 1995 to remediate and help prevent the migration of TCE and other VOCs from the soils into the Memphis Sand aquifer. The MPA system was shutdown in January 2002 pending repairs and a performance evaluation. System repairs were conducted at the MPA during early 2004 and the system was reactivated and optimized in April 2004 to improve mass removal in shallow zones from 0 to 15 feet below ground surface (bgs). The MPA system operated continuously from April 2004 until it was shutdown and abandoned in August 2004 due to expansion of the Main Facility Building. The MPA system was reconstructed in 2004 and 2005 and consists of an SVE system and an SSV system. The reconstruction of the MPA system was completed in October 2005 and the reconstructed MPA system was activated in December 2005. The system operated continuously from December 2005 (startup) through December 2011 with the exception of few temporary shutdowns pending repairs and/or vapor-phase GAC change-outs. The reconstructed MPA operation and performance results from 2007-2008 were presented in the *2007-2008 Annual Progress Report*.

The O&M information of the reconstructed MPA system from January 2010 through December 2011 is presented in the following sections of this report.



3.1.1 MPA System Operation

The reconstructed MPA system ran continuously as designed throughout the reporting period with the exception of few temporary shutdowns pending repairs and/or vapor-phase GAC change-outs. The total down time of the reconstructed MPA system during the 2010-2011 period was approximately 16 days.

As discussed in the *Initial Operation and Performance Memorandum* [XDD, 2006] and the *2006 Annual Progress Report*, at startup, the reconstructed MPA SVE system was configured to operate on approximately half of the total wells which produced the greatest chlorinated VOC vapor concentrations (a total of 54 SVE wells including: 25 shallow, 27 deep, and two deep sand wells), in accordance with the *Scope of Work: Reconstruction of Main Plant Area Remedial System* (XDD, 2004). These 54 wells are identified in **Figure D-1 (Appendix D)**. The system operated in this configuration until October 2010. Low level influent TCE vapor concentrations showed a declining trend between January 2010 and October 2010.

In October 2010, the system was reconfigured to operate on the remaining SVE wells which were previously inactive (a total of 32 SVE wells including, 14 shallow, 18 deep, and 0 deep sand wells). These 32 non-highlighted wells are identified in **Figure D-1 (Appendix D)**. The system operated in this configuration until August 2011. Low level influent TCE vapor concentrations were fairly stable between October 2010 and August 2011, with exception to a slight increase in concentration immediately following the SVE well reconfiguration.

In August 2011, the system was reconfigured to operate on the SVE wells which showed the highest VOC concentrations via field PID testing (a total of 41 SVE wells including, 20 shallow, 19 deep, and 2 deep sand wells) throughout the remainder of the reporting period. These most recent operating wells are identified in **Figure D-2 (Appendix D)**. Low level TCE vapor concentrations have shown a slight increase following the SVE well reconfiguration. The system is currently operating in this configuration.

Both the Shallow and the Deep SVE systems operated at or above the design flow throughout the reporting period. The combined average air flow rate from both the Shallow and Deep systems during the reporting period was approximately 870 standard cubic feet per minute (scfm).

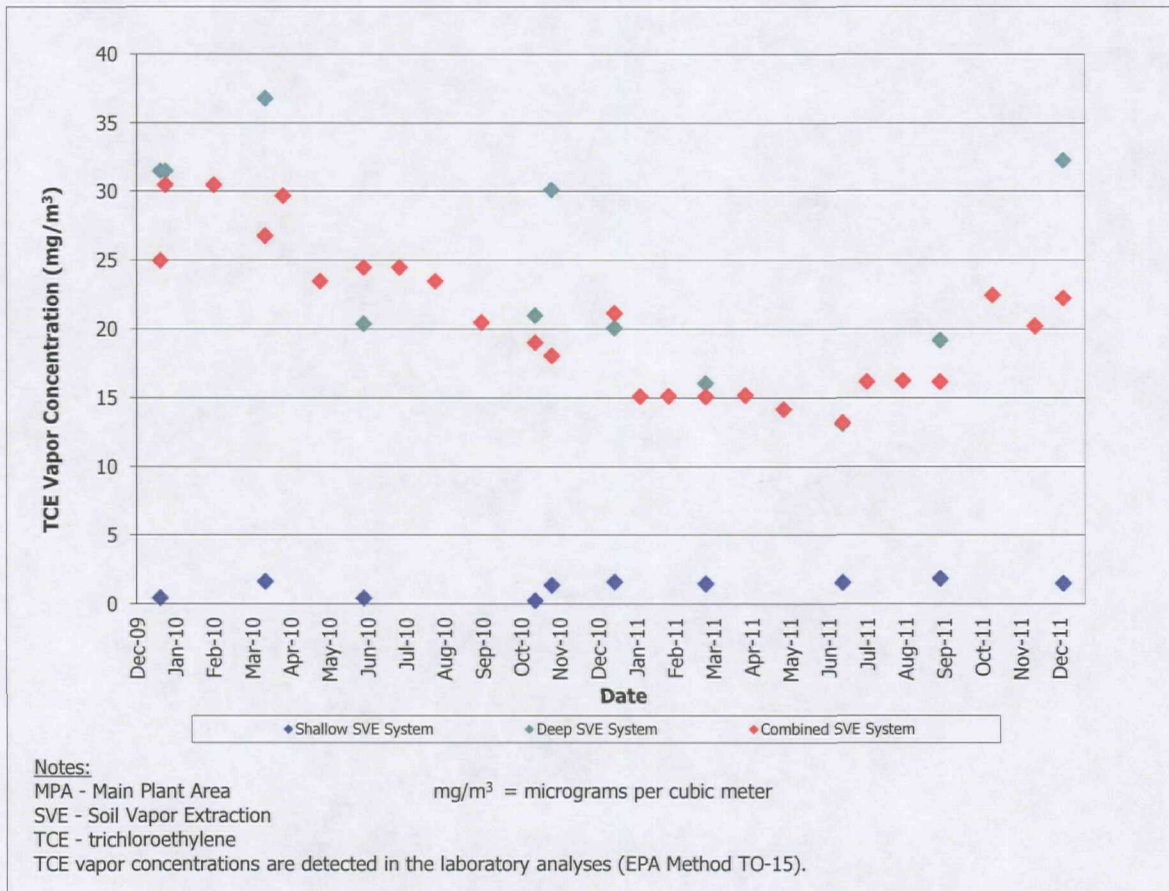
At startup (December 2005), the SSV system was configured to operate on all three SSV system legs (Legs A, B, and C), and this configuration did not change throughout the reporting period. The layout of the SSV system horizontal well screens and legs is presented in **Figure D-3 (Appendix D)**.

3.1.2 MPA System Analytical Results

Routine performance sampling of the reconstructed MPA system included approximately monthly sampling of five points along vapor treatment train and approximately weekly sampling of three points along the aqueous treatment train. Vapor samples were collected at the inlet of each SVE system (shallow and deep SVE systems), at the combined system inlet, between the two vapor-phase GAC units, and at the effluent of the vapor-phase GAC units (system effluent sample) for laboratory VOC analysis per USEPA Method TO-15, approximately on a quarterly basis. The vapor samples were collected monthly at the combined system inlet, and between and after the two vapor-phase GAC units were used to monitor the adsorptive capacity of the GAC units and determine when a change-out of the carbon was necessary. If condensate was generated and subsequently discharged, water samples (i.e., condensate water from the air moisture separators) were collected before, between, and after the liquid-phase GAC units on a routine basis and analyzed for the required parameters (i.e., VOCs, total suspended solids, pH) in accordance with the POTW discharge permit. The process and instrumentation diagram (P&ID) of the reconstructed MPA system showing the sampling locations is presented in **Figure D-4 (Appendix D)**.

The reconstructed MPA SVE system performance vapor sampling results from 2010 and 2011 are presented graphically on **Figure 3-1**. The laboratory analytical results are included in **Appendix A**.

Figure 3-1 Reconstructed MPA Influent TCE Vapor Concentrations (2010-2011)



As presented in **Figure 3-1**, as of December 6, 2011, the TCE vapor concentrations in the Shallow, Deep, and combined (total) systems influent are on average 0.5 mg/m³, 31.5 mg/m³, and 25 mg/m³, respectively.

3.1.3 MPA System Performance

The reconstructed MPA system performance data and TCE mass removal calculations for 2010 and 2011 are presented in **Appendix E** and summarized in **Table 3-1**.

Table 3-1
Reconstructed MPA TCE Mass Removal (2010 & 2011)

Date	Shallow SVE System		Deep SVE System		Combined SVE System		Effluent TCE Vapor Concentration (mg/m ³)
	Influent TCE Vapor Concentration (mg/m ³)	TCE Mass Removed (lbs)	Influent TCE Vapor Concentration (mg/m ³)	TCE Mass Removed (lbs)	Influent TCE Vapor Concentration (mg/m ³)	TCE Mass Removed (lbs)	
Dec-09	0.5	--*	31.5	--*	25	--*	BDL
Jan-10	--	--	--	--	30.5	20.8	0.148
Feb-10	--	--	--	--	30.5	90.7	0.011
Mar-10	1.7	2.5	36.8	162.8	26.8	91.0	0.017
Apr-10	--	--	--	--	29.7	32.0	0.007
May-10	--	--	--	--	23.5	61.9	0.004
Jun-10	0.5	0.7	20.4	84.7	24.5	65.0	0.004
Jul-10	--	--	--	--	24.5	54.6	0.003
Aug-10	--	--	--	--	23.5	53.3	BDL
Sep-10	--	--	--	--	20.5	63.0	BDL
Oct-10	0.27	0.6	21	151.8	19.05	65.8	BDL
Nov-10	1.38	0.3	30.1	21.1	18.1	18.8	BDL
Dec-10	1.61	1.4	20.1	53.1	21.16	74.0	0.007
Jan-11	--	--	--	--	15.13	28.3	0.011
Feb-11	--	--	--	--	15.15	26.7	0.0062
Mar-11	1.48	1.89	16.1	61.5	15.1	35.3	BDL
Apr-11	--	--	--	--	15.2	37.9	0.0072
May-11	--	--	--	--	14.2	35.2	--
Jun-11	1.56	3.0	13.2	75.9	13.22	50.1	BDL
Jul-11	--	--	--	--	16.2	22.0	BDL
Aug-11	--	--	--	--	16.27	35.4	BDL
Sep-11	1.85	2.5	19.2	78.7	16.2	36.6	BDL
Oct-11	--	--	--	--	22.48	64.4	0.0035
Nov-11	--	--	--	--	20.25	56.2	BDL
Dec-11	1.51	3.3	32.3	214.7	22.26	75.4	0.013
2010-2011 Total		16.3		1,159**		1,175.3	

Notes:

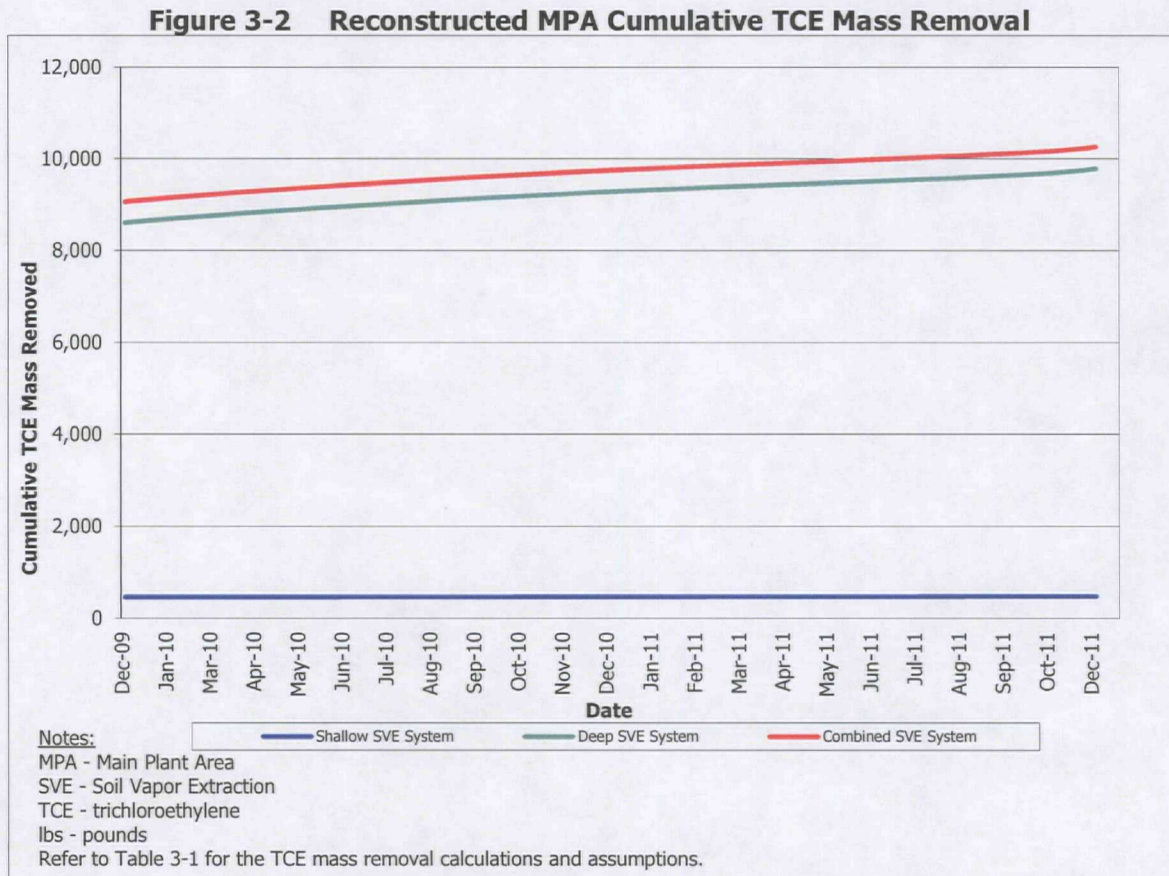
* : As presented in the 2007-2008 Annual Progress Report, the TCE mass removal through the combined Shallow and Deep systems from November 30, 2005 (initial startup) through December 2, 2008 was estimated to be 8,336 lbs. The TCE mass removal from December 2, 2008 through December 31, 2009 was estimated to be 733 lbs. The combined (total) were calculated based upon the TCE mass removed from the Shallow and the Deep SVE systems.

** : Total based on monthly combined influent minus the quarterly shallow to address the lower accuracy of quarterly versus monthly results.

TCE : trichloroethylene
mg/m³ : milligrams per cubic meter
lbs : pounds
BDL : Below detection level
-- : Not measured



The reconstructed MPA SVE system cumulative TCE mass removal estimates for the reporting period are presented graphically on **Figure 3-2**.



As presented in **Table 3-1**, the reconstructed MPA SVE system removed approximately 1,175 lbs (combined mass removed from both the Shallow and the Deep SVE systems) of TCE during 2010 and 2011. The TCE mass removed by the Shallow and Deep SVE systems during the reporting period is estimated to be 16.3 lbs and 1,159 lbs, respectively. As presented in **Figure 3-2**, approximately **10,244 lbs** of TCE has been removed by the reconstructed MPA SVE system since its startup in December 2005 through December 2011. Prior to this, the old MPA system recovered approximately 3,916 lbs of TCE during its nine years of operation (1995 to 2004). Therefore, the removal rates have been significantly increased since the startup of the

reconstructed MPA system. A combined total of 14,160 lbs of TCE have been recovered by both the old and reconstructed MPA systems.

Based upon the laboratory analytical results of the air discharge compliance sampling performed during the reporting period, the VOC vapor concentrations at the discharge stack have been in compliance with the air discharge permit.

The TCE mass removed through the system's water stream was relatively insignificant (less than 1 lb), and therefore, was not incorporated in the TCE mass removal calculations. During 2010 and 2011, no system water was generated, treated, or discharged to the sanitary sewer system. No water discharge compliance sampling was performed (required to remain in compliance with the POTW discharge permit) during the reporting period.

3.1.4 MPA System O&M

Routine Operation and Maintenance (O&M) inspections of the MPA system were conducted on a minimum of a monthly basis during the 2010-2011 reporting period for equipment replacement/repairs, routine maintenance, and vapor-phase GAC change-outs. A total of three vapor-phase GAC change-outs were performed in March 2010, October 2010, and June 2011 during the reporting period.

3.1.5 MPA Planned 2012 Activities

At this time, Carrier is planning to perform the following activities in 2012:

- Continue to operate the reconstructed MPA system in the current well field configuration while maintaining balanced air flow rates at all wells that are operational.
- Continue to collect vapor and water samples from the system as described in Section 3.1.2 of this report.
- Continue to monitor the trends in the system's influent TCE vapor concentrations over time and the overall TCE mass removal rate.

As discussed in the *Scope of Work* (XDD, 2004), the reconstructed MPA system is designed to operate initially in a cyclic manner, with approximately half of the total wells operating at a time. When the system influent TCE vapor concentrations and the overall TCE mass removal rates are observed to have declined to asymptotic levels, the system well field will be reconfigured. This will involve reconfiguring the wells based on field VOC sampling to focus airflow on only those wells that exhibit the highest VOC vapor concentrations and have the highest removal rates.

As discussed in the *Initial Operation and Performance Memorandum*, the *2006 Annual Progress Report*, and the *2007-2008 Annual Progress Report*, when the system influent TCE vapor concentration trends become asymptotic and/or concentrations drop to non-detectable levels, then wellhead rebound soil vapor sampling may be implemented to evaluate system progress towards closure. The trends in wellhead vapor concentrations under static conditions would be evaluated to determine if concentrations are remaining relatively constant or increasing (rebounding). If the TCE levels in soil vapor are not rebounding, then the soils in the vicinity of the respective SVE wells may have achieved stabilization.

As stated in the ROD, the cleanup level for the TCE contaminated soil will be approximately 533 micrograms per kilogram ($\mu\text{g/Kg}$) or until in USEPA's determination, it is demonstrated that contaminant levels have ceased to decline over time, and are remaining constant at some statistically significant level above remediation levels in the area of remediation, as verified by confirmatory soil sampling. However, due to access restrictions inside the facility manufacturing building (i.e., presence of manufacturing equipment), the confirmatory soil samples from the MPA may not be collected. Therefore, alternative approaches to verify compliance with the soil cleanup level (i.e., utilizing soil gas sampling data to verify compliance) will be evaluated.

3.2 NRS

The NRS was installed in 1989 to address the historical TCE releases in the former sludge lagoon area northwest of the manufacturing facility. Installed initially as a treatability study, the NRS was successful in its objectives to prevent migration of contaminants into the Memphis

Sand aquifer. Since the treatability test was successful as installed, operation was selected as the long-term Site remedy in this area. The NRS operated continuously until it was shutdown in October 2001 pending repairs and a performance evaluation. System repairs were conducted during early 2003 and the system was reactivated in November 2003. The system was optimized in early 2004 to target the shallower regions in the target area. The system operated continuously during the 2004-2007 period with the exception of few temporary shutdowns pending repairs. The NRS operation and performance results from 2007-2008 were presented in the *2007-2008 Annual Progress Report*.

The O&M information of the NRS from January 2010 through December 2011 is presented in the following sections of this report.

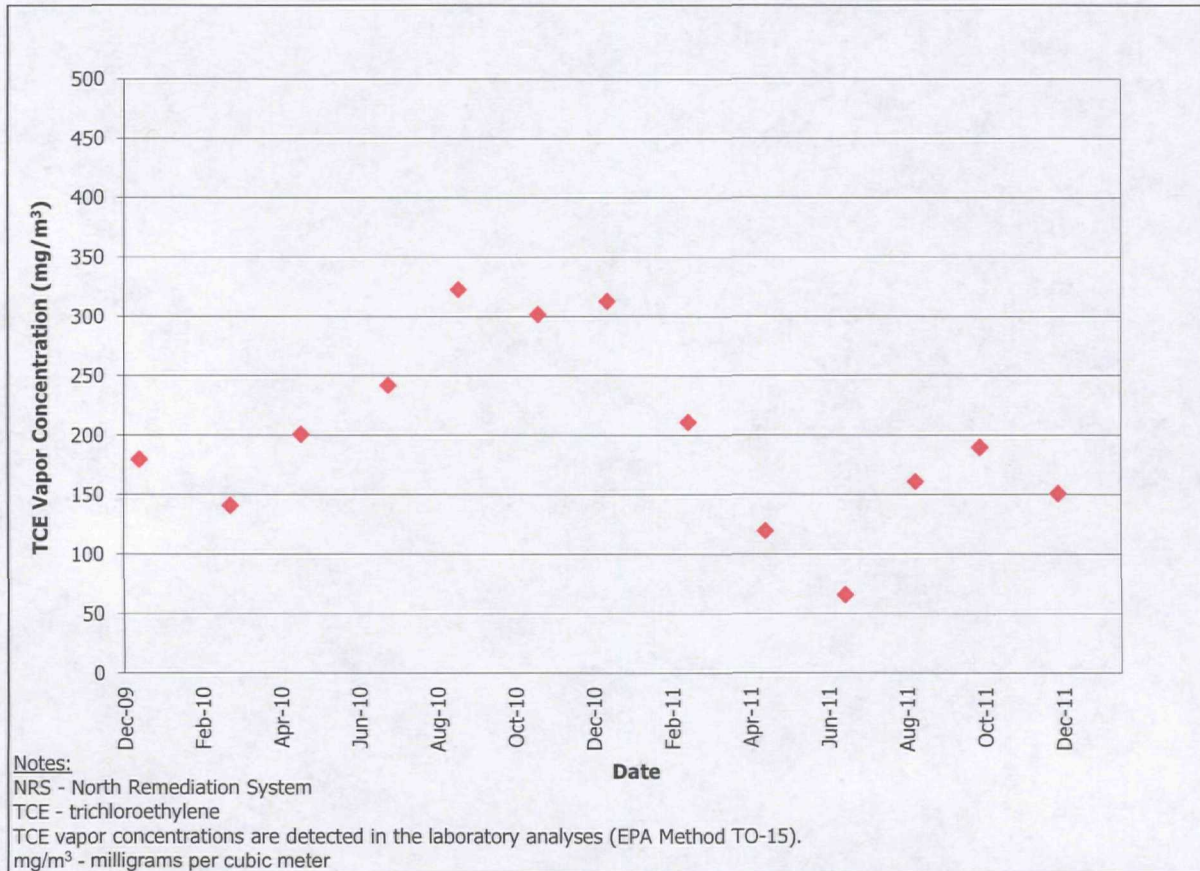
3.2.1 NRS Operation

The NRS ran continuously as designed throughout the reporting period with the exception of few temporary shutdowns pending non-routine repairs and maintenance. The total down time of the reconstructed NRS during the 2010-2011 period was approximately 28 days. The average air flow rate from the NRS during the reporting period was approximately 135 scfm.

3.2.2 NRS Analytical Results

During 2010 and 2011, effluent vapor samples were collected from the system on a bi-monthly basis and analyzed for VOCs per USEPA Method TO-15. The analytical results were used to evaluate the overall performance of the system and to estimate overall TCE mass removal. The NRS performance vapor sampling results from 2010 and 2011 are presented graphically on **Figure 3-3**. The laboratory analytical results are included in **Appendix A**.

Figure 3-3 NRS Influent/Effluent TCE Vapor Concentrations (2010-2011)



As presented in **Figure 3-3**, the TCE vapor concentrations in system influent/effluent were typical and varied in concentrations ranging from 66 mg/m³ to 320 mg/m³ during the reporting period.

3.2.3 NRS Performance

The NRS performance data and TCE mass removal calculations for 2010 and 2011 are presented in **Appendix F** and summarized in **Table 3-2**.

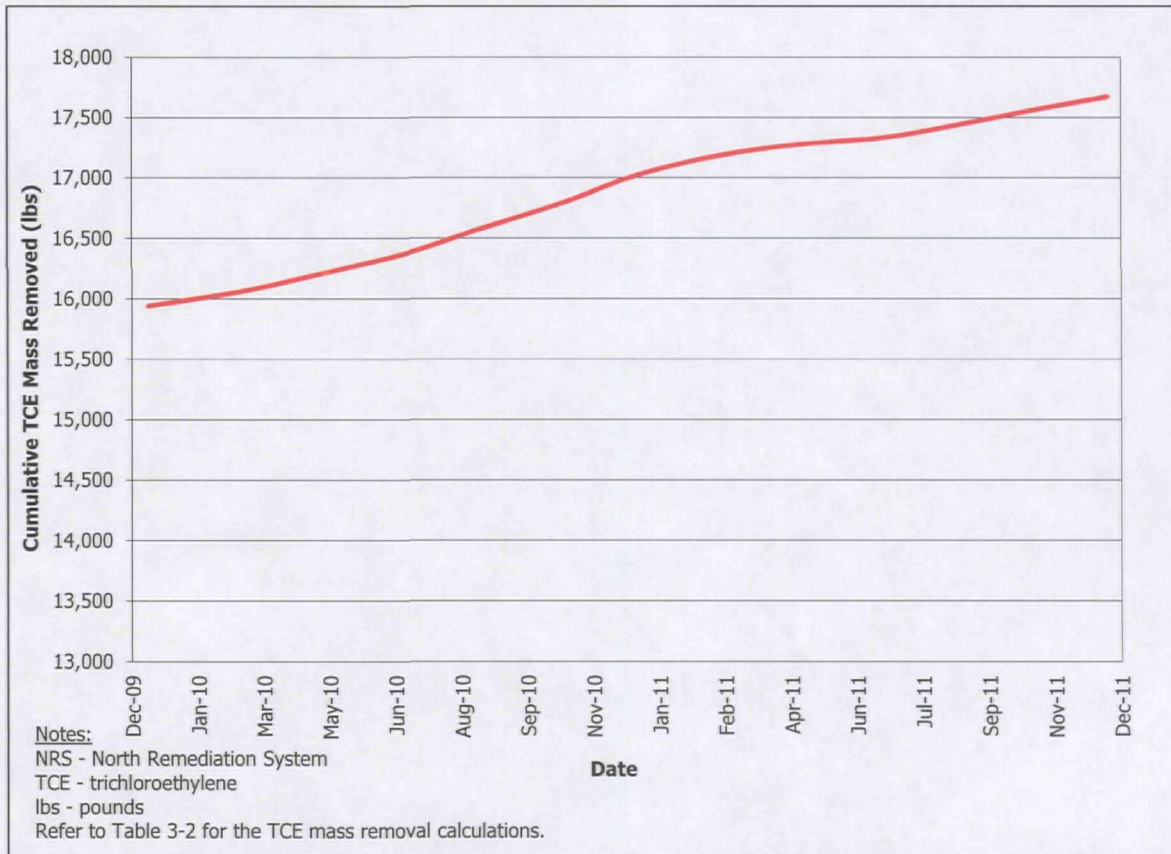
Table 3-2 NRS TCE Mass Removal (2010 - 2011)			
Date	Air Flow rate (scfm)	Influent / Effluent TCE Concentrations (mg/m ³)	TCE Mass Removed (lbs)
12/15/09	135	180	-
02/25/10	139	140	126
04/22/10	136	200	136
06/30/10	118	240	176
08/25/10	126	320	203
10/27/10	127	300	215
12/21/10	146	310	224
02/23/11	140	20	168
04/25/11	138	120	91
06/27/11	145	66	54
08/22/11	133	160	107
10/12/11	127	190	110
12/13/11	149	150	124
2010-2011 Total			1,734

Notes:

TCE : trichloroethylene
 scfm : standard cubic feet per minute
 mg/m³ : milligrams per cubic meter
 lbs : pounds

The NRS cumulative TCE mass removal estimates are presented graphically on **Figure 3-4**.

Figure 3-4 NRS Cumulative TCE Mass Removal



As presented in **Table 3-2**, approximately 1,734 lbs of TCE was removed from the NRS during 2010 and 2011. As presented in Figure 3-4, over 17,691 lbs of TCE has been removed from the NRS since its startup in 1989 through December 2011. Noting the system modifications/optimizations performed in 2003 and 2004, the TCE mass removal rates from the NRS for 2010 and 2011 are comparable to historical rates.

The NRS did not generate any water during 2010 and 2011.

3.2.4 NRS O&M

As discussed previously in this report, the NRS ran continuously during 2010 and 2011 with exception to a few temporary shutdowns pending routine maintenance.

3.2.5 NRS Planned 2012 Activities

As of this report, Carrier is planning to perform the following activities in 2012:

- Continue to operate the NRS system following the same protocols as 2010 and 2011.
- Continue to collect vapor samples from system influent for laboratory VOC analysis on a bi-monthly basis.

Similar to the MPA system, when the NRS influent TCE vapor concentration trends become asymptotic and/or concentrations drop to non-detectable levels, then wellhead rebound soil vapor sampling may be implemented to evaluate system progress towards closure. If the TCE levels in soil vapor are not rebounding, confirmatory soil sampling will be performed to verify compliance with the soil cleanup level for closure.

4.0 2010-2011 CONCLUSIONS

Operations at the Carrier Site are proceeding in accordance with recent modifications and interim plans. As indicated in the *2009 Five-Year Review*, the remedies implemented at the MPA, NRS, and WP#2 for the Site are protective of human health and the environment. Further, conditions at the Site are not expected to change in the near future, given the local area's land use (industrial/commercial) and zoning controls currently in place.

Based upon the current concentration trends at the WP#2, MW-60 and MW-62 and the remedial progress made at the MPA, NRS, and WP#2 to date, Carrier is proposing that the current reporting frequency be changed from annually to a standard five-year basis. Carrier requests that the proposed change in the reporting frequency be granted before the end of year 2012. Pending USEPA's approval of this request, future progress information and data at the site will be provided in the subsequent five-year reviews with the first one occurring in 2015. Upon USEPA's request, Carrier will provide supplemental systems performance information in a letter or memorandum format.

4.1 Groundwater Results and Conclusions

As discussed in the *2007-2008 Annual Progress Report*, and the *2009 Five-Year Review Report*, WP#2 is integral to the containment of the TCE plume within the Memphis Sand aquifer. Because of the depth and complexity of the aquifer, alternative treatment technologies are not feasible. Moreover, because the large body of analytical data collected at WP#2 since contamination was first detected in the Town of Collierville's wells, is a key indicator of contaminant migration and the effectiveness of source area remedial actions. The significant decrease in TCE concentrations at WP#2 observed between 2008 and 2011 and the continuous decreasing trend in TCE concentrations are likely a result of the ongoing remedial operations and progress at WP#2. The non-detect TCE concentrations in downgradient monitoring wells MW-60 and MW-62 continue to indicate that plume containment at WP#2 is ongoing. Further, monitoring of wells MW-60 and MW-62 performed during the 2007 interim shutdown of WP#2 confirms that temporary cessation in pumping of WP#2 (i.e., 12 months) does not impact the remedy performance and that the groundwater TCE plume remains contained.



Given these conclusions, Carrier will pursue the following actions in 2012:

- Carrier will continue to monitor MW-4, MW-10, and MW-31R on a semi-annual basis.
- WP#2 continues to operate in interim status, providing containment of the TCE plume and discharging to the Town of Collierville's POTW.
- Carrier will continue to monitor the raw/influent water concentrations at WP#2 bi-monthly to gauge the effectiveness and progress of the source area remediation systems.
- Carrier will monitor MW-60 and MW-62 bi-monthly to assess the containment of the TCE plume on site.

4.2 Soil Results and Conclusions

At the conclusion of 2011, both the MPA and the NRS SVE systems were operating normally and no non-routine maintenance issues were anticipated. TCE mass removal rates at the MPA have significantly decreased since the startup of the reconstructed MPA system in December 2005. TCE mass removal rates at the NRS have also decreased since the last system optimization that was performed in 2003 and 2004.

The reconstructed MPA system ran continuously during 2010 and 2011, with the exception of few temporary shutdowns pending repairs and/or vapor-phase GAC change-outs, and removed approximately 1,175 lbs of TCE. As of this report, over 14,160 lbs of TCE has been removed from the MPA since its startup in 1995. Carrier proposes continued operation of the MPA in 2012.

The NRS operated continuously during 2010 and 2011, with the exception of some non-routine maintenance, and removed approximately 1,734 lbs of TCE; the total TCE removal since 1989 is over 17,691 lbs. Carrier proposes continued operation of the NRS in 2012.

5.0 REFERENCES

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E², Inc. (2010, June 23). *Carrier Air Conditioning Site, 2009 Five-Year Review*

APPENDIX A
Laboratory Analytical Results
(Attached CD)

APPENDIX B
Water Plant #2 Monthly Flow Data

APPENDIX B
Water Plant #2 Monthly Flow Data
Carrier Air Conditioning Site
Collierville, TN

Sampling Date	Stripper Effluent Flow Totalizer Reading (total gallons)
01-04-10	691,223,491
01-25-10	691,237,747
01-25-10	691,260,263
01-27-10	692,008,102
01-28-10	692,702,206
02-03-10	692,706,460
02-04-10	693,232,504
02-05-10	693,236,556
02-08-10	695,035,396
02-12-10	695,038,985
02-14-10	696,431,646
02-15-10	696,431,646
02-17-10	696,432,841
02-18-10	697,057,644
02-23-10	698,986,106
02-25-10	700,946,120
02-26-10	701,539,615
03-01-10	703,517,882
03-02-10	704,134,299
03-08-10	708,052,074
03-09-10	708,102,668
03-16-10	708,104,992
03-16-10	708,112,962
04-01-10	708,811,659
04-02-10	709,479,409
04-05-10	709,784,694
04-06-10	710,449,998
04-07-10	711,093,945
04-08-10	711,214,847
04-13-10	713,910,037
04-14-10	714,597,173
04-15-10	715,066,997
04-16-10	715,699,651
04-19-10	717,516,650
04-20-10	718,140,816
04-21-10	718,721,924
04-22-10	719,307,540
04-23-10	719,891,270
04-26-10	719,968,653
04-27-10	719,989,925
04-28-10	720,599,400
04-29-10	711,217,146
05-04-10	722,039,985
05-05-10	722,040,024
05-06-10	722,617,367
05-07-10	722,767,363
05-10-10	724,448,637
05-12-10	725,003,894
05-13-10	725,635,278
05-14-10	726,175,922
05-14-10	726,181,877
05-14-10	726,187,207
05-17-10	726,191,122
05-18-10	726,810,690
05-20-10	727,454,900
05-21-10	727,458,180
05-24-10	729,159,739
05-25-10	729,240,086
05-26-10	729,252,369
05-27-10	729,833,944
05-28-10	731,539,171
05-31-10	732,303,682
06-08-10	736,787,194
06-09-10	737,262,398
06-10-10	737,825,835
06-11-10	738,409,235
06-14-10	740,177,399
06-18-10	741,551,876
06-22-10	741,584,341
06-23-10	742,181,745
06-24-10	742,475,999
06-29-10	743,381,040
06-30-10	743,970,092
07-01-10	744,719,215
07-02-10	745,258,687
07-06-10	747,689,611
07-07-10	748,222,714
07-08-10	748,831,882
07-09-10	749,428,652
07-12-10	749,505,981
07-16-10	749,506,880
07-26-10	755,066,821

Sampling Date	Stripper Effluent Flow Totalizer Reading (total gallons)
07-27-10	755,104,151
07-28-10	755,105,206
07-29-10	755,715,240
09-02-10	755,716,359
09-02-10	755,726,319
09-07-10	757,895,766
09-08-10	758,080,159
09-08-10	758,096,465
09-10-10	758,263,529
09-13-10	759,649,371
09-16-10	760,448,604
09-17-10	760,547,270
09-18-10	761,200,593
09-21-10	761,820,934
09-24-10	763,557,717
10-01-10	767,690,577
10-04-10	769,413,066
10-14-10	773,648,320
10-14-10	773,651,899
10-18-10	776,007,903
10-19-10	776,629,322
10-20-10	777,239,175
10-21-10	777,876,658
10-22-10	778,373,420
10-25-10	779,679,799
10-26-10	780,165,524
10-28-10	780,659,274
10-28-10	781,302,597
11-01-10	783,036,969
11-02-10	783,602,938
11-04-10	783,603,674
11-05-10	784,303,736
11-08-10	786,134,395
11-09-10	786,650,280
11-10-10	787,181,170
11-10-10	787,188,658
11-15-10	788,549,580
11-15-10	788,577,459
11-16-10	788,717,600
11-18-10	788,792,830
11-22-10	791,199,103
11-23-10	791,267,039
01-05-11	791,267,039
01-19-11	791,270,835
01-27-11	791,272,076
01-28-11	791,902,073
01-31-11	793,545,871
02-01-11	793,597,161
02-08-11	793,598,488
02-09-11	794,204,913
02-10-11	794,695,579
02-11-11	795,298,858
02-22-11	800,844,864
02-23-11	801,343,412
02-25-11	801,493,623
03-01-11	801,928,545
03-02-11	802,524,629
03-03-11	803,159,140
03-04-11	803,654,029
03-07-11	803,753,022
03-08-11	804,272,270
03-11-11	804,835,569
03-14-11	805,949,783
03-15-11	806,074,924
03-16-11	806,620,598
03-17-11	807,107,657
03-18-11	807,699,855
03-21-11	809,322,387
03-23-11	810,476,083
03-24-11	811,029,918
03-25-11	811,621,637
03-28-11	811,627,936
04-01-11	811,719,942
04-04-11	813,294,453
04-06-11	813,425,975
04-12-11	815,851,595
04-13-11	815,964,432
04-14-11	816,513,225
04-15-11	816,549,825
04-19-11	817,235,729
04-20-11	817,364,888
05-10-11	817,369,484

Sampling Date	Stripper Effluent Flow Totalizer Reading (total gallons)
05-11-11	817,941,712
05-13-11	819,131,644
05-23-11	823,173,277
05-25-11	823,185,766
05-26-11	823,201,453
05-31-11	825,904,940
06-01-11	826,484,143
06-02-11	827,048,755
06-07-11	829,780,873
06-10-11	831,525,866
06-13-11	832,199,653
06-16-11	832,332,336
06-27-11	836,728,579
06-28-11	837,150,431
07-05-11	839,678,387
07-06-11	840,199,104
07-07-11	840,261,637
07-13-11	841,485,460
07-14-11	841,949,677
07-19-11	844,252,106
07-20-11	844,254,458
07-25-11	844,257,580
08-01-11	846,644,841
08-02-11	847,193,743
08-03-11	847,702,260
08-04-11	848,316,871
08-05-11	848,320,291
08-16-11	849,326,156
08-17-11	849,717,784
08-19-11	849,777,472
08-22-11	850,323,820
08-23-11	850,842,946
08-24-11	851,244,676
08-25-11	851,244,676
08-29-11	852,966,294
08-30-11	853,515,744
08-31-11	854,075,809
09-02-11	855,123,137
09-06-11	856,135,416
09-07-11	856,248,610
09-08-11	856,774,998
09-13-11	859,460,977
09-15-11	860,035,213
09-16-11	860,578,391
09-19-11	861,988,247
09-20-11	861,988,247
09-21-11	862,576,966
09-23-11	863,516,760
09-26-11	864,877,728
09-27-11	865,423,536
09-29-11	855,422,883
10-03-11	868,639,820
10-04-11	869,196,649
10-05-11	869,755,633
10-06-11	870,235,412
10-11-11	873,012,777
10-12-11	873,557,293
10-13-11	873,666,887
10-14-11	874,208,606
10-17-11	875,816,652
10-18-11	876,316,378
10-19-11	876,384,799
10-21-11	877,482,395
10-24-11	878,576,670
10-25-11	879,007,699
10-26-11	879,651,328
10-27-11	879,711,164
11-07-11	883,037,997
11-08-11	883,583,269
11-09-11	883,649,509
11-11-11	884,186,817
11-14-11	885,761,662
11-15-11	885,950,926
11-17-11	885,983,285
11-18-11	886,590,966
11-21-11	887,803,291
12-06-11	889,040,363
12-12-11	890,671,085
12-13-11	891,219,627
12-15-11	891,984,191
12-19-11	893,629,723
12-21-11	893,650,649

APPENDIX C
Water Plant #2 TCE Mass Removal Calculations

Appendix C
Water Plant#2 TCE Mass Removal Calculations
Carrier Air Conditioning Site
Collierville, TN

Month	Influent Concentrations		Total Flow (gallons)	Mass Removed	
	cis- 1,2 DCE (µg/L)	TCE (µg/L)		cis- 1,2 DCE (lbs)	TCE (lbs)
January-10	< 2.0	25.0	1,478,715	0	0.31
February-10	< 2.0	25.0*	10,815,676	0	2.26
March-10	< 2.0	23.9	5,293,777	0	1.06
April-10	< 2.0*	23.9*	13,228,326	0	2.64
May-10	< 2.0*	23.9*	14,747,209	0	2.94
June-10	< 2.0	29.0	7,932,021	0	1.92
July-10	< 2.0*	29.0*	10,996,025	0	2.66
August-10	--	--	--	--	--
September-10	< 2.0	31.5	11,975,337	0	3.15
October-10	< 2.0*	31.5*	15,346,392	0	4.04
November-10	< 2.0*	31.5*	8,230,070	0	2.16
December-10	--	--	--	--	--
January-11	< 2.0*	31.5*	2,330,122	0	0.61
February-11	< 2.0	43.7	8,331,384	0	3.04
March-11	< 2.0*	43.7*	9,791,397	0	3.57
April-11	< 2.0	34.8	5,644,946	0	1.64
May-11	< 2.0*	34.8*	9,119,255	0	2.65
June-11	< 2.0*	34.8*	13,194,244	0	3.83
July-11	< 1.0	46.9	6,966,454	0	2.73
August-11	< 1.0*	46.9*	8,478,296	0	3.32
September-11	< 1.0	39.6	13,516,683	0	4.47
October-11	< 1.0	39.0	14,398,177	0	4.69
November-11	< 1.0*	39.0*	6,002,366	0	1.95
December-11	< 1.0*	39.0*	4,610,286	0	1.50
2010 - 2011 Total			202,427,158	0.0	57.1

Notes:

$$\text{Mass Removed} = \text{Flowrate} \left(\frac{\text{gal}}{\text{month}} \right) \times \left(\frac{1 \text{ L}}{0.264 \text{ gal}} \right) \times \text{Concentration} \left(\frac{\mu\text{g}}{\text{L}} \right) \times \left(\frac{1 \text{ g}}{10^6 \mu\text{g}} \right) \times \left(\frac{1 \text{ lbs}}{453.6 \text{ g}} \right)$$

TCE : trichloroethylene

cis- 1,2 DCE : cis- 1,2 dichloroethylene

µg/L : micrograms per liter

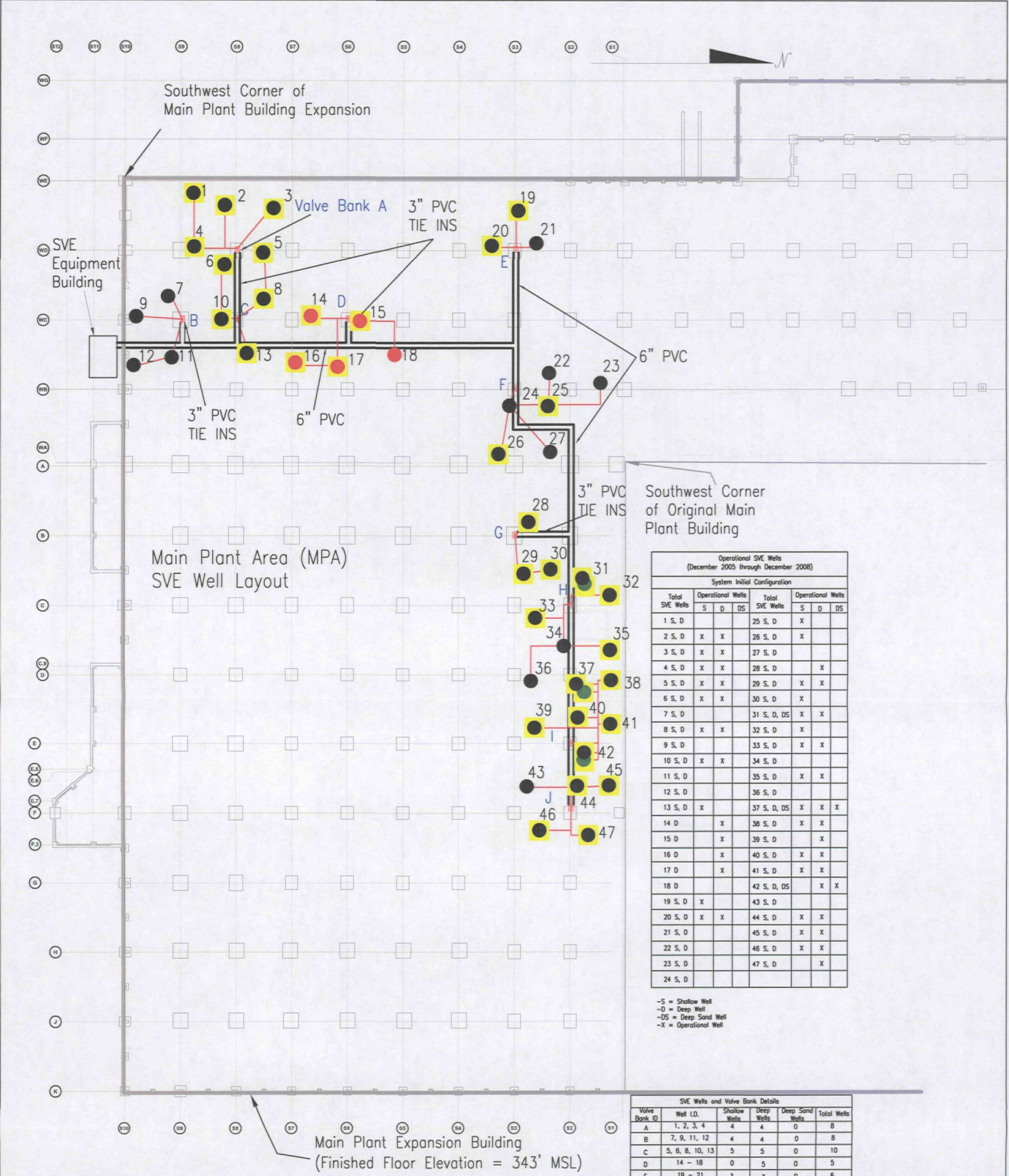
lbs : pounds

<2.0 : Not detected - Chemicals below lab reporting/qualification limit

a : Result is from Run #2

* Results assumed from previous results.

Appendix D
Reconstructed MPA SVE and SSV As-Built Drawings



Operational SVE Wells (December 2005 through December 2008)							
System Initial Configuration							
Total SVE Wells	Operational Wells			Total SVE Wells	Operational Wells		
	S	D	DS		S	D	DS
1 S, D				25 S, D	X		
2 S, D	X	X		26 S, D	X		
3 S, D	X	X		27 S, D			
4 S, D	X	X		28 S, D		X	
5 S, D	X	X		29 S, D	X	X	
6 S, D	X	X		30 S, D	X		
7 S, D				31 S, D, DS	X	X	
8 S, D	X	X		32 S, D	X		
9 S, D				33 S, D	X	X	
10 S, D	X	X		34 S, D			
11 S, D				35 S, D	X	X	
12 S, D				36 S, D			
13 S, D	X			37 S, D, DS	X	X	X
14 D		X		38 S, D	X	X	
15 D		X		39 S, D		X	
16 D		X		40 S, D	X	X	
17 D		X		41 S, D	X	X	
18 D				42 S, D, DS		X	X
19 S, D	X			43 S, D			
20 S, D	X	X		44 S, D	X	X	
21 S, D				45 S, D	X	X	
22 S, D				46 S, D	X	X	
23 S, D				47 S, D		X	
24 S, D							

-S = Shallow Well
-D = Deep Well
-DS = Deep Sand Well
-X = Operational Well

SVE Wells and Valve Bank Details					
Valve Bank ID	Well I.D.	Shallow Wells	Deep Wells	Deep Sand Wells	Total Wells
A	1, 2, 3, 4	4	4	0	8
B	7, 9, 11, 12	4	4	0	8
C	5, 6, 8, 10, 13	5	5	0	10
D	14 - 18	0	5	0	5
E	19 - 21	3	3	0	6
F	22 - 27	6	6	0	12
G	28 - 30	3	3	0	6
H	31 - 36	6	6	1	13
I	37 - 42	6	6	2	14
J	43 - 47	5	5	0	10

-Shallow Well: Screen Interval = 6.5-11.5' BFF
-Deep Well: Screen Interval = 16.5-26.5' BFF
-Deep Sand Well: Screen Interval = 33-43' BFF

LEGEND

- Single Soil Vapor Extraction (SVE) Well (Deep Sand)
 - Dual Level Soil Vapor Extraction Well (Shallow and Deep)
 - Single Level Soil Vapor Extraction Well (Deep)
 - SVE Main Line (Overhead; 6" ID PVC, SCH 40)
 - SVE Branch Line (Below Slab; 2" ID PVC, SCH 80)
 - Valve Bank Location
 - Operational SVE Wells for System Initial Configuration (December 2005 through March 2006)
- NOTES:
- SVE Borings are spaced approximately 40' on center (ROI=20 feet).
 - MSL = feet above mean sea level
 - BFF = below finished floor
 - ROI = radius of influence
 - SVE well locations are surveyed.
 - Shallow wells are operated by the Shallow SVE Skid (Shallow SVE process equipment)
 - Deep and Deep Sand wells are operated by the Deep SVE Skid (Deep SVE process equipment)

35' 0' 35' 70'

SCALE: 1" = 70'

DATE: JULY 2009

PROJECT NO.: 73271

CLIENT: UTC - COLLIERVILLE

DRAWN BY: MAW

CHECKED BY: OU

PROJ. MGMT. APPROVAL: BC

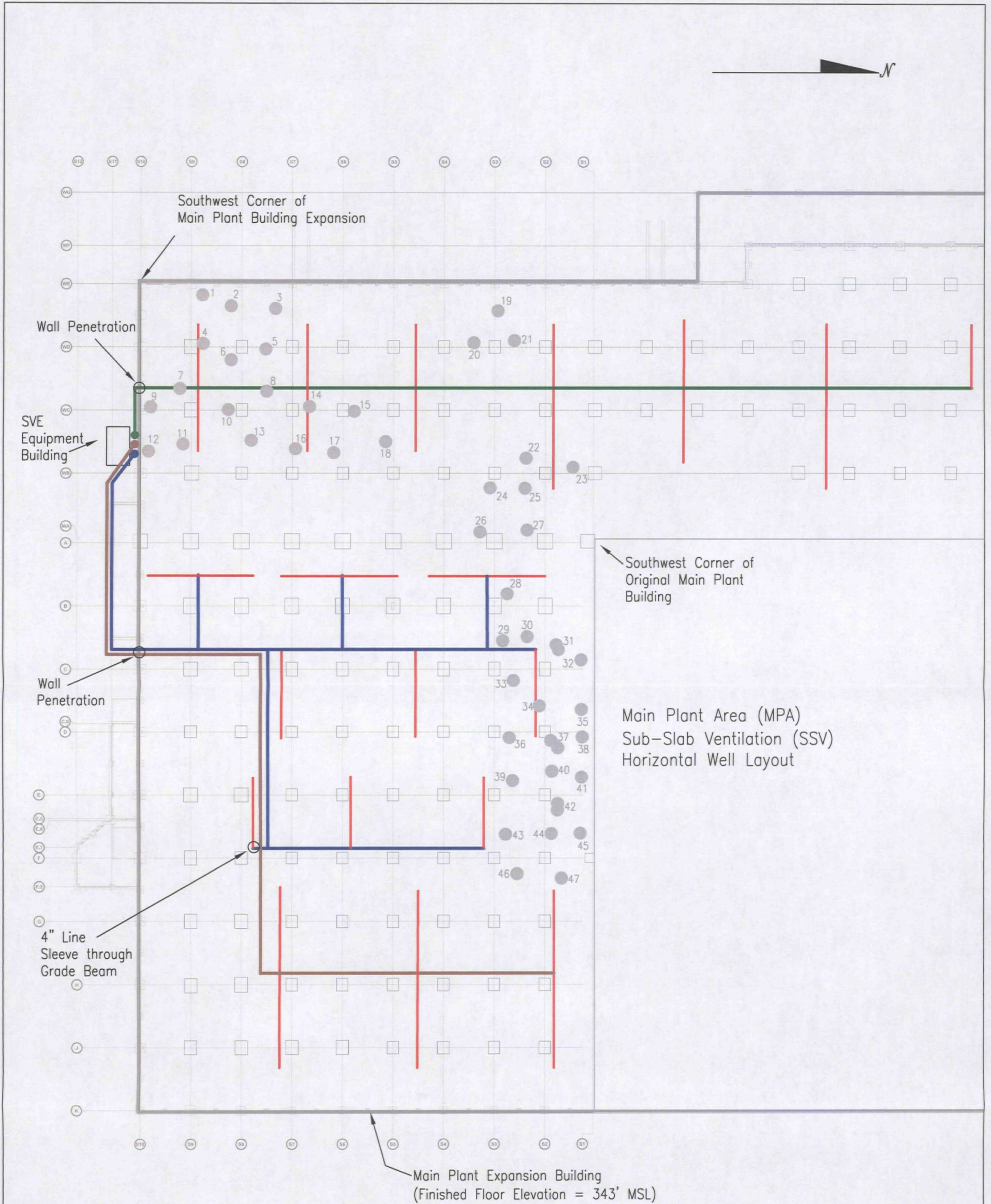


STRATEGIC. ENVIRONMENTAL. SOLUTIONS.

TITLE: Reconstructed MPA SVE Initial Well Field Configuration (Operational SVE Wells)
UTC - Carrier Air Conditioning, Collierville, TN

DRAWING NO.: D-1

REV: A



LEGEND

- Soil Vapor Extraction (SVE) Wells
- Subslab Ventilation (SSV) Branch Line/Leg A (Below grade, 4" ID PVC, SCH 80)
- SSV Branch Line/Leg B (Below grade, 4" ID PVC, SCH 80)
- SSV Branch Line/Leg C (Below grade, 4" ID PVC, SCH 80)
- SSV Horizontal Well Screen (2" ID PVC, SCH 40, 100' On-Center, 50' ROI, 50' L, 20-Slot)

NOTES

- SVE Borings are spaced approximately 40' on center (20 feet ROI).
- "MSL" = feet above mean sea level
- SVE well locations are surveyed.
- ROI = radius of influence

0' 75'

SCALE: 1" = 75'
DATE: JULY 2007
PROJECT NO.: 73271
CLIENT: UTC - COLLIERVILLE
DRAWN BY: MAW
CHECKED BY: OU
PROJ. MGMT. APPROVAL: BC

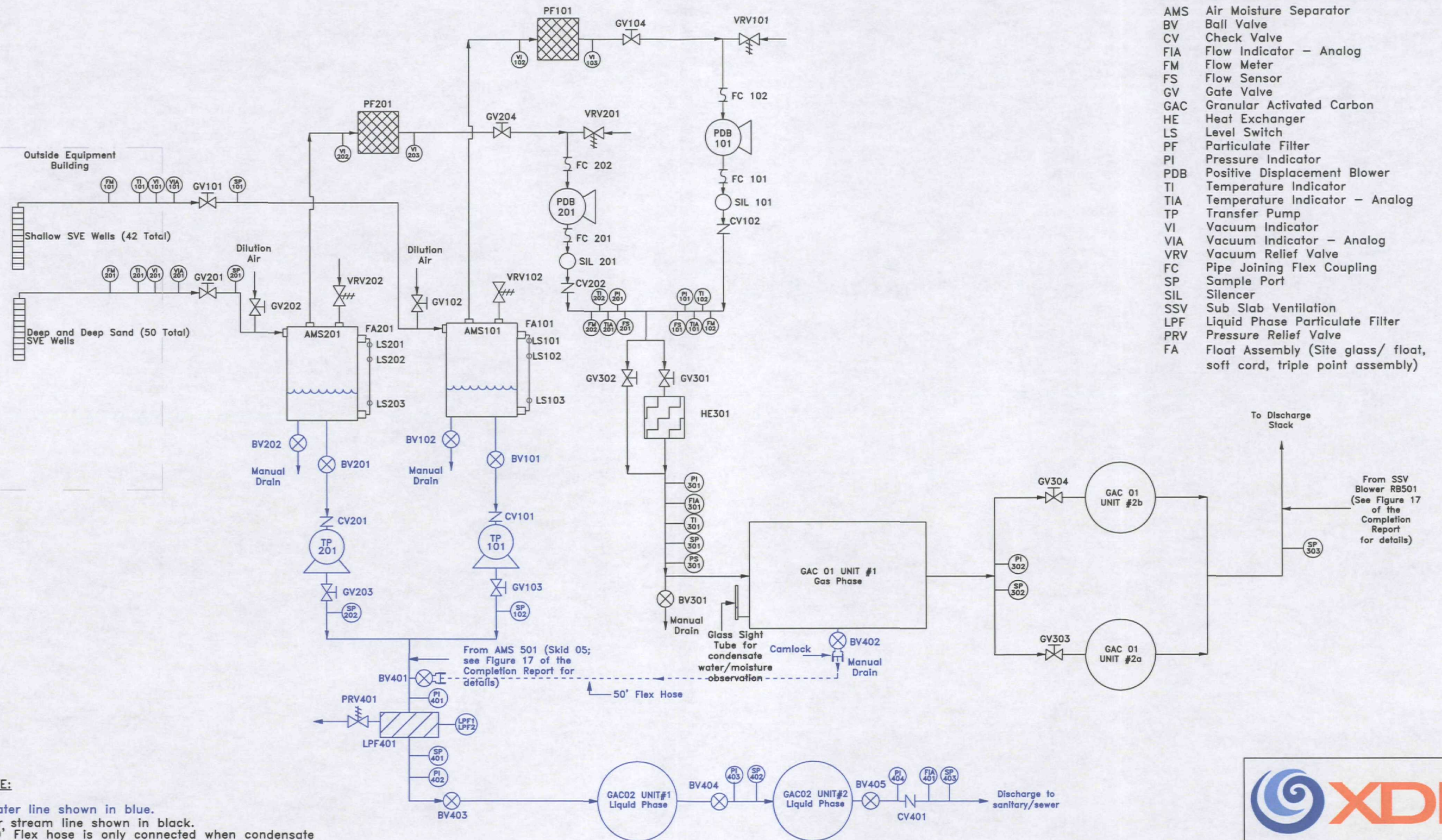


STRATEGIC. ENVIRONMENTAL. SOLUTIONS.

TITLE: *Reconstructed MPA SSV Horizontal Well Layout and Manifold*
UTC - Carrier Air Conditioning, Collierville, TN

DRAWING NO.: D-3	REV: A
------------------	--------

AMS	Air Moisture Separator
BV	Ball Valve
CV	Check Valve
FIA	Flow Indicator - Analog
FM	Flow Meter
FS	Flow Sensor
GV	Gate Valve
GAC	Granular Activated Carbon
HE	Heat Exchanger
LS	Level Switch
PF	Particulate Filter
PI	Pressure Indicator
PDB	Positive Displacement Blower
TI	Temperature Indicator
TIA	Temperature Indicator - Analog
TP	Transfer Pump
VI	Vacuum Indicator
VIA	Vacuum Indicator - Analog
VRV	Vacuum Relief Valve
FC	Pipe Joining Flex Coupling
SP	Sample Port
SIL	Silencer
SSV	Sub Slab Ventilation
LPF	Liquid Phase Particulate Filter
PRV	Pressure Relief Valve
FA	Floater Assembly (Site glass/ floater, soft cord, triple point assembly)



- Water line shown in blue.
- Air stream line shown in black.
- 50' Flex hose is only connected when condensate water/moisture is indicated in the sight tube.



SCALE: NOT TO SCALE	TITLE: Reconstructed MPA SVE Process Overview Diagram UTC - Carrier Air Conditioning, Collierville, TN	
DATE: JULY 2007		
PROJECT NO.: 73271		
CLIENT: UTC - COLLIERVILLE		
DRAWN BY: MAW	DRAWING NO.: D-4	REV: A
CHECKED BY: OU		
PROJ. MGMT. APPROVAL: BC		

APPENDIX E

Reconstructed MPA Performance Data and TCE Mass Removal Calculations

Appendix E
Reconstructed MPA Performance Data and TCE Mass Removal Calculations
Carrier Air Conditioning Site
Collierville, TN

Shallow SVE System (2010–2011)						
Date	Air Flow rate (scfm)	Air Flow Rate (m ³ /min)	Influent TCE Vapor Concentration (µg/m ³)	TCE Mass Removal Rate (lbs/day)	Elapsed Days of Operation	TCE Mass Removed (lbs)
12/31/09**	200	5.7	460	--	--	--
01/04/2010	--	--	--	--	--	--
02/11/2010	--	--	--	--	--	--
03/23/2010	200	5.7	1,650	0.03	82	2.51
04/06/2010	--	--	--	--	--	--
05/05/2010	--	--	--	--	--	--
06/08/2010	200	5.7	450	0.01	77	0.7
07/06/2010	--	--	--	--	--	--
08/03/2010	--	--	--	--	--	--
09/08/2010	--	--	--	--	--	--
10/20/2010	200	5.7	270	0.01	134	0.65
11/02/2010	200	5.7	1,380	0.03	13	0.32
12/21/2010	200	5.7	1,610	0.03	49	1.42
01/10/2011	--	--	--	--	--	--
02/01/2011	--	--	--	--	--	--
03/02/2011	200	5.7	1,480	0.03	71	1.89
04/02/2011	--	--	--	--	--	--
05/02/2011	--	--	--	--	--	--
06/17/2011	200	5.7	1,560	0.02	107	3.0
07/06/2011	--	--	--	--	--	--
08/03/2011	--	--	--	--	--	--
09/01/2011	200	5.7	1,850	0.02	76	2.53
10/12/2011	--	--	--	--	--	--
11/14/2011	--	--	--	--	--	--
12/06/2011	200	5.7	1,510	0.01	121	3.29
2010–2011 Total						16.3

$$\text{Mass Removal Rate} = \text{Flowrate} \left(\frac{\text{m}^3}{\text{min}} \right) \times \text{Concentration} \left(\frac{\mu\text{g}}{\text{m}^3} \right) \times \left(\frac{1 \text{ lbs}}{453.6 \times 10^6 \mu\text{g}} \right) \times \left(\frac{1440 \text{ min}}{\text{day}} \right)$$

Notes:

- ** : As presented in the 2006 Annual Progress Report, the TCE mass removal through the Shallow SVE system from November 30, 2005 (initial Startup) through December 4, 2006 was estimated to be 404 lbs.
- * : Data assumed from previous measurements.
- : Not measured or not calculated
- scfm : standard cubic feet per minute
- TCE : trichloroethylene
- µg/m³ : micrograms per cubic meter
- m³/min : cubic meter per minute
- lbs : pounds
- lbs/day : pounds per day

Appendix E
Reconstructed MPA Performance Data and TCE Mass Removal Calculations
Carrier Air Conditioning Site
Collierville, TN

Deep SVE System (2010–2011)						
Date	Air Flow rate (scfm)	Air Flow Rate (m³/min)	Influent TCE Vapor Concentration (µg/m³)	TCE Mass Removal Rate (lbs/day)	Elapsed Days of Operation	Cumulative TCE Mass Removed (lbs)
12/31/2009	600	17	31,500	--	--	--
1/4/2010	--	--	--	--	--	--
2/11/2010	--	--	--	--	--	--
3/23/2010	600	17	36,800	1.99	82	162.8
4/6/2010	--	--	--	--	--	--
5/5/2010	--	--	--	--	--	--
6/8/2010	600	17	20,400	1.1	77	84.7
7/6/2010	--	--	--	--	--	--
8/3/2010	--	--	--	--	--	--
9/8/2010	--	--	--	--	--	--
10/20/2010	600	17	21,000	1.13	134	151.8
11/2/2010	600	17	30,100	1.62	13	21.1
12/21/2010	600	17	20,100	1.08	49	53.1
01/10/11	--	--	--	--	--	--
02/01/11	--	--	--	--	--	--
03/02/11	600	17	16,100	0.9	71	61.5
04/02/11	--	--	--	--	--	--
05/02/11	--	--	--	--	--	--
06/17/11	600	17	13,200	0.7	107	75.9
07/06/11	--	--	--	--	--	--
08/03/11	--	--	--	--	--	--
09/01/11	600	17	19,200	1.0	76	78.7
10/12/11	--	--	--	--	--	--
11/14/11	--	--	--	--	--	--
12/6/2011	600	17	32,300	1.75	121	214.7
2010-2011 Total						904.5

$$\text{Mass Removal Rate} = \text{Flowrate} \left(\frac{\text{m}^3}{\text{min}} \right) \times \text{Concentration} \left(\frac{\mu\text{g}}{\text{m}^3} \right) \times \left(\frac{1 \text{ lbs}}{453.6 \times 10^6 \mu\text{g}} \right) \times \left(\frac{1440 \text{ min}}{\text{day}} \right)$$

Notes:

- ** : As presented in the 2006 Annual Progress Report, the TCE mass removal through the Deep SVE system from November 30, 2005 (initial startup) through December 4, 2006 was estimated to be 4,517 lbs.
- * : Data assumed from previous measurements.
- : Not measured or not calculated
- scfm : standard cubic feet per minute
- TCE : trichloroethylene
- µg/m³ : micrograms per cubic meter
- m³/min : cubic meter per minute
- lbs : pounds
- lbs/day : pounds per day

Appendix E
Reconstructed MPA Performance Data and TCE Mass Removal Calculations
Carrier Air Conditioning Site
Collierville, TN

Combined SVE System (2010–2011)						
Date	Air Flow rate (scfm)	Air Flow Rate (m³/min)	Influent TCE Vapor Concentration (µg/m³)	TCE Mass Removal Rate (lbs/day)**	Elapsed Days of Operation	TCE Mass Removed (lbs)**
12/31/2009	858.4	24.31	24,000	--	--	--
1/4/2010	874.1	24.75	30,500	2.4	4	9.6
2/11/2010	866.1	24.53	30,500	2.4	38	90.2
3/23/2010	903.4	25.58	26,800	2.2	40	87.0
4/6/2010	898.4	25.44	29,700	2.4	14	33.6
5/5/2010	887.3	25.13	23,500	1.9	29	54.3
6/8/2010	884.3	25.04	24,500	1.9	34	66.2
7/6/2010	888.6	25.17	24,500	2.0	28	54.8
8/3/2010	875	24.78	23,500	1.8	28	51.8
9/8/2010	895.3	25.35	20,500	1.6	36	59.4
10/20/2010	867.5	24.57	19,050	1.5	42	62.4
11/2/2010	867.5	24.57	18,100	1.4	13	18.3
12/21/2010	844.9	23.93	21,160	1.6	49	78.8
01/10/11	902.4	25.56	15,130	1.2	20	24.5
02/01/11	878.9	24.89	15,150	1.2	22	26.3
03/02/11	910.6	25.79	15,100	1.2	29	35.8
04/02/11	886.4	25.10	15,200	1.2	31	37.5
05/02/11	888.4	25.16	14,200	1.1	30	34.0
06/17/11	878.1	24.87	1,322	1.0	46	48.0
07/06/11	872.5	24.71	16,200	1.3	19	24.1
08/03/11	862.0	24.41	16,270	1.3	28	35.3
09/01/11	867.6	24.57	16,200	1.3	29	36.6
10/12/11	830.4	23.52	22,480	1.9	41	77.1
11/14/11	840.0	23.79	20,250	1.5	33	50.5
12/6/2011	854.0	24.19	22,260	1.7	47	79.0
2010-2011 Total						1,175.3

$$\text{Mass Removal Rate} = \text{Flowrate} \left(\frac{\text{m}^3}{\text{min}} \right) \times \text{Concentration} \left(\frac{\mu\text{g}}{\text{m}^3} \right) \times \left(\frac{1 \text{ lbs}}{453.6 \times 10^6 \mu\text{g}} \right) \times \left(\frac{1440 \text{ min}}{\text{day}} \right)$$

Notes:

- * : As presented in the 2006 Annual Progress Report, the TCE mass removal through the combined Shallow and Deep systems from November 30, 2005 (initial startup) through December 4, 2006 was estimated to be 4,921 lbs.
- ** : The combined (total) SVE system TCE mass removal rates and mass removal from December 4, 2006 through December 2, 2008 were calculated based upon the TCE mass removed from the Shallow and the Deep SVE systems.
- : Not measured or not calculated
- scfm : standard cubic feet per minute
- TCE : trichloroethylene
- µg/m³ : micrograms per cubic meter
- m³/min : cubic meter per minute
- lbs : pounds
- lbs/day : pounds per day

APPENDIX F
NRS Performance Data and TCE Mass Removal Calculations

Appendix F
NRS Performance Data and TCE Mass Removal Calculations
Carrier Air Conditioning Site
Collierville, TN

NRS Performance Data and TCE Mass Removal (2010-2011)						
Date	Air Velocity (LFM)	Flow Rate (m³/min)	Concentration (µg/m³)	Mass Removal (lbs/day)	Elapsed Days of Operation	Total Mass Removed (lbs)
12/15/09	6207	3.84	180	-	-	-
02/25/10	6381	3.94	140	1.75	72	126
04/22/10	6210	3.84	200	2.32	56	136
06/30/10	5419	3.35	240	2.55	69	176
08/25/10	5777	3.57	320	3.63	56	203
10/27/10	5810	3.59	300	3.42	63	215
12/21/10	6705	4.14	310	4.08	55	224
02/23/11	6401	3.96	210	2.64	64	168
04/25/11	6343	3.92	120	1.49	61	91
06/27/11	6641	4.10	66	0.86	63	54
08/22/11	6107	3.77	160	1.92	56	107
10/12/11	5810	3.59	190	2.17	51	110
12/13/11	6811	4.21	150	2.0	62	124
2010-2011 Total						1,734

$$\text{Mass Removal Rate} = \text{Flowrate} \left(\frac{\text{m}^3}{\text{min}} \right) \times \text{Concentration} \left(\frac{\mu\text{g}}{\text{m}^3} \right) \times \left(\frac{1 \text{ lbs}}{453.6 \times 10^6 \mu\text{g}} \right) \times \left(\frac{1440 \text{ min}}{\text{day}} \right)$$

Notes:

- * : As presented in the 2006 Annual Progress Report, the TCE mass removal through the NRS from 1989 (initial startup) through December 6, 2006 was estimated to be 14,014 lbs.
- : Not measured or not calculated
- LFM : Linear Feet per minute
- µg/m³ : micrograms per cubic meter
- lbs : pounds
- lbs/day : pounds per day
- m³/min : cubic meter per minute
- TCE : Trichloroethylene
- NRS : North Remediation System